Stanley W. Meso
WIL 5-4
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Weyerhaeuser Company
Timberland Division

Forestry Research Center
Centralia, Washington

Forestry Research Note

Number 34

December 1960

REDUCTION OF RISK OF LOSSES BY THE DOUGLAS-FIR BEETLE AND AMBROSIA BEETLES: AN INTERIM GUIDE

by

Norman E. Johnson[1/]

Most foresters have encountered the Douglas-fir beetle, (Dendroctonus pseudotsugae Hopk)and realize the great damage that this insect causes. For example, Wright and Lauterbach (1958) reported that on the Millicoma Tree Farm, 548,005,000 board feet of living sawtimber was killed by the Douglas-fir beetle from 1951 to 1954. The effect that this sudden and unexpected loss of timber can have on management plans is pointed out by Cornelius (1955) and Smyth (1959). Accompanying the tree killing by Douglas-fir beetles is the damage caused by wood-boring insects, primarily ambrosia beetles, in the early stages of tree deterioration. As reported by McMullen (1956) ambrosia beetles may cause up to 64 percent reduction in value of certain classes of lumber and as much as 36 percent in plywood veneer. As stated by Johnson (1958) even the presence of a single pinhole can degrade a piece of lumber that would otherwise grade "B or Btr." to "D" with a loss of over one-third of the value at the retail level.

Although we will continue to experience losses from these insects, there are a number of precautions that can be taken to reduce damage to a minimum. It is the purpose of this paper to present a few of these precautions.

[1/]Forest Entomologist, Weyerhaeuser Company Forestry Research Center, Centralia, Washington

THE INSECTS INVOLVED

Early indications of attacks by Douglas-fir beetles are evidenced by small piles of red-orange boring dust that collect in bark crevices. The boring dust is particularly conspicuous in the spring of the year during time of maximum beetle attack. Attacks occur to a lesser degree throughout the remainder of the summer. The adult beetle (the female does most of the work) constructs an egg gallery in the phloem parallel to the grain of the wood. This gallery may be up to 2 feet long, but it usually averages 6 to 10 inches. After the eggs are laid along the sides of the gallery, the larvae hatch and mine at right angles to the egg gallery, destroying the inner phloem and cambium as they go. When fully grown, the larvae are over a quarter of an inch long and are white except for a brown head. The larvae transform to adults in chambers at the ends of the larval mines. The new adults overwinter in the log and emerge the following spring to initiate their own egg galleries in fresh timber.

Ambrosia beetles also make little piles of boring dust, but in contrast to the red-orange of the Douglas-fir beetle, it is white. This is because the ambrosia beetles bore into the sapwood. The tunnels made by ambrosia beetles usually are dark in color due to staining caused by the fungi that became established on the walls of the tunnels.

CONDITION FOR ATTACK AND SURVIVAL

There is abundant evidence to show that tree killing by the Douglas-fir beetle follows years of heavy windthrow. This fact is clearly shown by Wright and Lauterbach (1958). The removal of infested trees and logs from the woods has long been recommended as a means to reduce bark beetle populations (Hopping, 1921). In order to be at all effective, however, infested material must be removed before March or April of the year following attack. The sooner infested material is removed the better for several reasons: (1) Parent beetles will be prevented from leaving the logs and making a second attack the same year. (2) Logs will still have a high proportion of the bark left on after logging. (3) Losses from wood-boring insects, blue stain and saprotting fungi will be minimized. (4) Fire hazard will be reduced.

Although quantitative data are not available, it is known that a certain percent of the female Douglas-fir beetles emerge from their first gallery and make a second attack and possibly third. Early logging will prevent or minimize this. The importance of the second attack in tree killing has not been determined, but it is felt by some workers that it may be significant. For example, McCowan and Rudinsky (1958) feel that the second attack may cause nearly as much mortality as the first. Rudinsky and Vite (1956) have shown that the Douglas-fir beetle can bore into the tree faster at the higher temperatures that prevail during the period of second attack. They suggest that the accelerated boring rate may help breakdown a tree's resistance. Merker and Muller (1951) postulate that during hot, dry weather trees are more attractive and susceptible to attack by bark beetles. Walters (1956) and Furniss (1956) disagree, feeling that because the second attack is less intense and more protracted than the first attack, it is less critical in respect to the infestation of living trees. In any event all authorities recommend early removal of infested logs.

After the Douglas-fir beetle broods have completed their galleries and the various staining and wood-rotting fungi have become well established, the bark becomes loosened so that it will slip from the log easily during logging. A recent study has shown that when bark is removed from the log, over half of the adult beetles fall to the forest floor and the remainder stay in the bark.[2/] Of the beetles that fell to the forest floor nearly 40 percent were alive after nearly 4 months. Of those remaining in the bark over 50 percent survived overwinter. Those beetles which remained on an undisturbed log had 84 percent overwintering survival. Again the importance of getting the logs out of the woods as soon as possible is emphasized.

Wright and Wright (1954) found blue-staining and saprotting fungi associated with attacks by the Douglas-fir beetle. They inidcated that trees heavily attacked with beetles had a higher initial decay rate than those that were not attacked. The study by the above authors indicated that even at the end of one year nearly 5 percent of the board foot volume may be lost and the remaining sapwood may be heavily stained. Except for ambrosia beetles, losses to other wood boring insects are minor until after the first year. Losses associated with attacks by ambrosia beetles, however, can be quite significant. Attacks by the ambrosia beetle Trypodendron lineatum can be expected to occur primarily in the spring

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2/ Johnson, Norman E. and Leon F. Pettinger. 1960. Overwintering Mortality of Douglas-fir Beetles in Infested Logs, Exposed Bark and Forest Litter in Western Washington. Weyerhaeuser Forestry Research Center. In manuscript. 14 pp.

of the year for a period of about one month. Kinghorn and Chapman (1954) report this period to be generally in May in British Columbia, but it will vary somewhat by area and year. The ambrosia beetle Gnathotrichus sulcatus attacks throughout the summer and in contrast to Trypodendron may attack some trees for a second year.

The increase in fire hazard caused by leaving windthrown timber in the woods is apparent. This important aspect should not be underestimated.

EFFECT OF LIGHT ON BROOD SURVIVAL AS INFLUENCED BY REMOVAL

It has been shown that attack intensity and brood survival of the Douglas-fir beetle is much less in those trees exposed to the direct rays of the sun than in those in shaded places (Johnson, Orr, and Wright, 1959). This is especially true in second-growth stands where attack intensity on logs exposed to the sun was only half and brood survival only a third as great as in shaded logs. Windthrow along the edges of logged areas is especially vulnerable to Douglas-fir beetle attack in that it is usually shaded enough to keep the broods from being killed by the sun and still it receives enough radiation to help the broods develop before winter. Also along the edges there is generally recurrent windthrow which helps to maintain high beetle populations.

RECOMMENDATIONS ON REMOVAL OF FRESH WINDTHROW

Practically all authorities recommend removal of infested windthrow, prior to emergence of bark beetle broods, as a means of reducing the insect population. As emphasized in the preceding paragraph, we feel this is important for several reasons. One should not, however, overlook the desirability of removing windthrow prior to infestation. Field studies give added incentive for doing this.3/ Examination of recent windthrow revealed that nearby living trees were also attacked. The proportion of trees attacked diminished with distance from the windthrow. The evidence here strongly indicates that a source of attraction for the area is set up by the recent wind-

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3/Johnson, Norman E., and L. F. Pettinger. 1960. Douglas-fir beetle attacks in living trees as influenced by the presence of fresh windthrow. Weyerhaeuser Forestry Research Center. In Manuscript. 6 pp.

throw. The beetles upon entering the zone or area of attraction are not able to distinguish a living tree from the windthrow. Actually western hemlock and western redcedar logs have been attacked near attractive windthrown Douglas-fir trees. Both of these species are not normally attacked. It was possible to induce attacks in living trees by placing a short section of freshly felled Douglas-fir next to the tree. Evidence to support the theory of area attraction is given by the recent article by Schwerdtfeger (1960) in which the same phenomenon was observed with pine.

If, following a large beetle population buildup in abundant windthrown trees the beetles are concentrated in relative few areas by new windthrow, they may attack the trees in high enough numbers to cause mortality. In years of low beetle population, however, trees in the vicinity of fresh windthrow might be attacked but with too few numbers to cause tree killing. Any factor that weakens the tree such as a drought, defoliation or fire damage would increase the probability of mortality.

SEASON OF FELLING

Studies conducted at Coos Bay indicate that the time of year trees are felled may influence the number of bark beetle attacks.[1/] Those trees felled in the spring of the year were attacked most heavily. Summer-felled trees were least attacked by beetles the following spring. Trees felled in the fall and winter were intermediate in susceptibility to attack in the spring. There is also an apparent difference in the number of ambrosia beetle attacks by the species Trypodendron lineatum with season of felling. Prebble and Graham (1957) and Johnson (1958) indicate that trees felled in the spring are least attacked, this species preferring trees felled 4 to 5 months prior to spring attack. In any case, logs felled after August and removed from the woods before April of the following year will create no threat so far as Douglas-fir beetle is concerned, will not be attacked by ambrosia beetle and will be little affected by fungi. The next best period of felling would seem to be in midsummer, after the peak of Douglas-fir beetle attack, with removal of the logs before spring. If logs must be left in the woods for periods longer than one year, trees felled in the late spring and summer will suffer less from the ambrosia beetle Trypodendron lineatum. This creates the dilemma

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1/ Unpublished Data, Weyerhaeuser Forestry Research Center

of spring-felled logs being most suitable for Douglas-fir beetle development. Here one must use judgment. If Douglas-fir beetle populations are excessive as in years of heavy windthrow, measures to control this insect should be given first consideration in preference to control of ambrosia beetles. Scheduling of felling time would appear to be quite important in road rights-of-way where the logs often lie on the ground for long periods.

RECOMMENDATIONS

1. Remove infested windthrow as soon as possible to prevent population buildups of the Douglas-fir beetle, to reduce losses caused by ambrosia beetles, saprotting and staining fungi and to reduce fire hazard.

2. In removing infested windthrow, high priority should be given to shaded and partially shaded material along cutting lines around rights-of-way in preference to material fully exposed to the sun.

3. Remove fresh windthrow to reduce sources of attraction for the beetles which may attack and kill living trees in the near vicinity.

4. For minimum attack and brood survival by the Douglas-fir beetle, fell road right-of-way trees in the late summer in preference to the winter and early spring. Where the Douglas-fir beetle is not a consideration, however, trees felled in the spring will suffer less damage from ambrosia beetles of the genus Trypodendron than logs felled in the fall and winter.

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